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Systems Group Chairman

***National Transportation Safety Board***  
Investigations Into Trans World Airlines Flight 800



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### From TWA 800:

- Damaged Wire Insulation  
(Mechanical Damage & Cracks)
- Repairs & Metal Shavings Along Wire  
Routes
- Repetitive Maintenance Write-ups  
(Refueling, Cabin Lights, Galley Leaks)



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## TWA 800 Maintenance

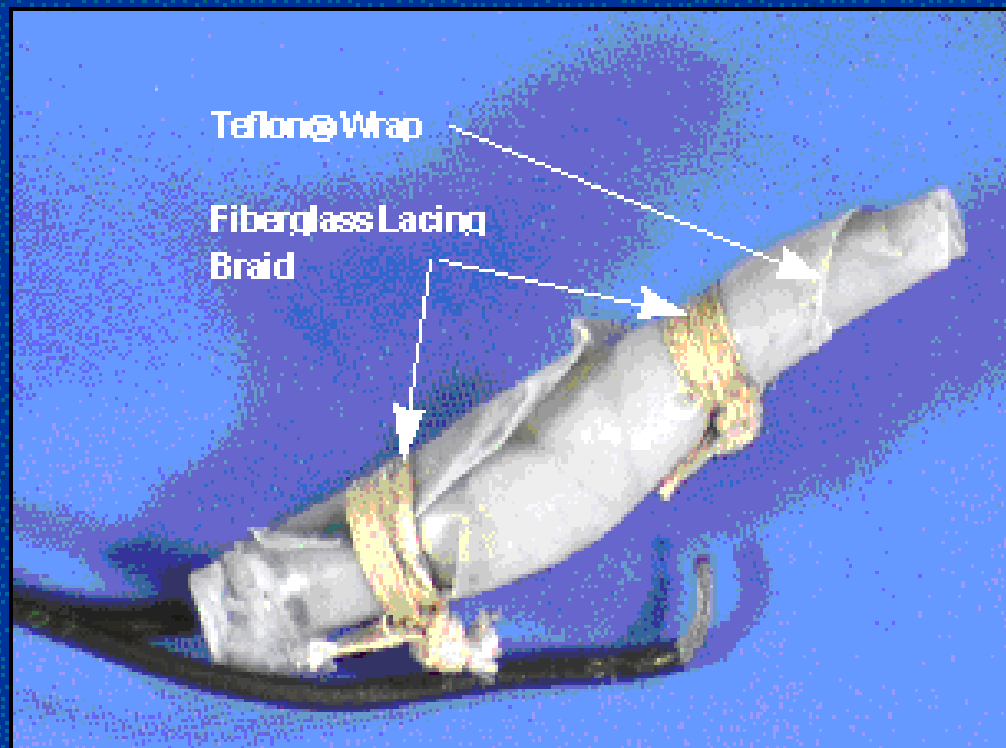
- Improper hardware and practices used for a wing tank compensator
- Open-ended Splices in Wet Areas
- Concentrations of Splices
- Improper Repair in Fuel Totalizer Gauge



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## Improper Wire Repair From TWA 800 Wing Fuel Tanks





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## Airplane Inspections

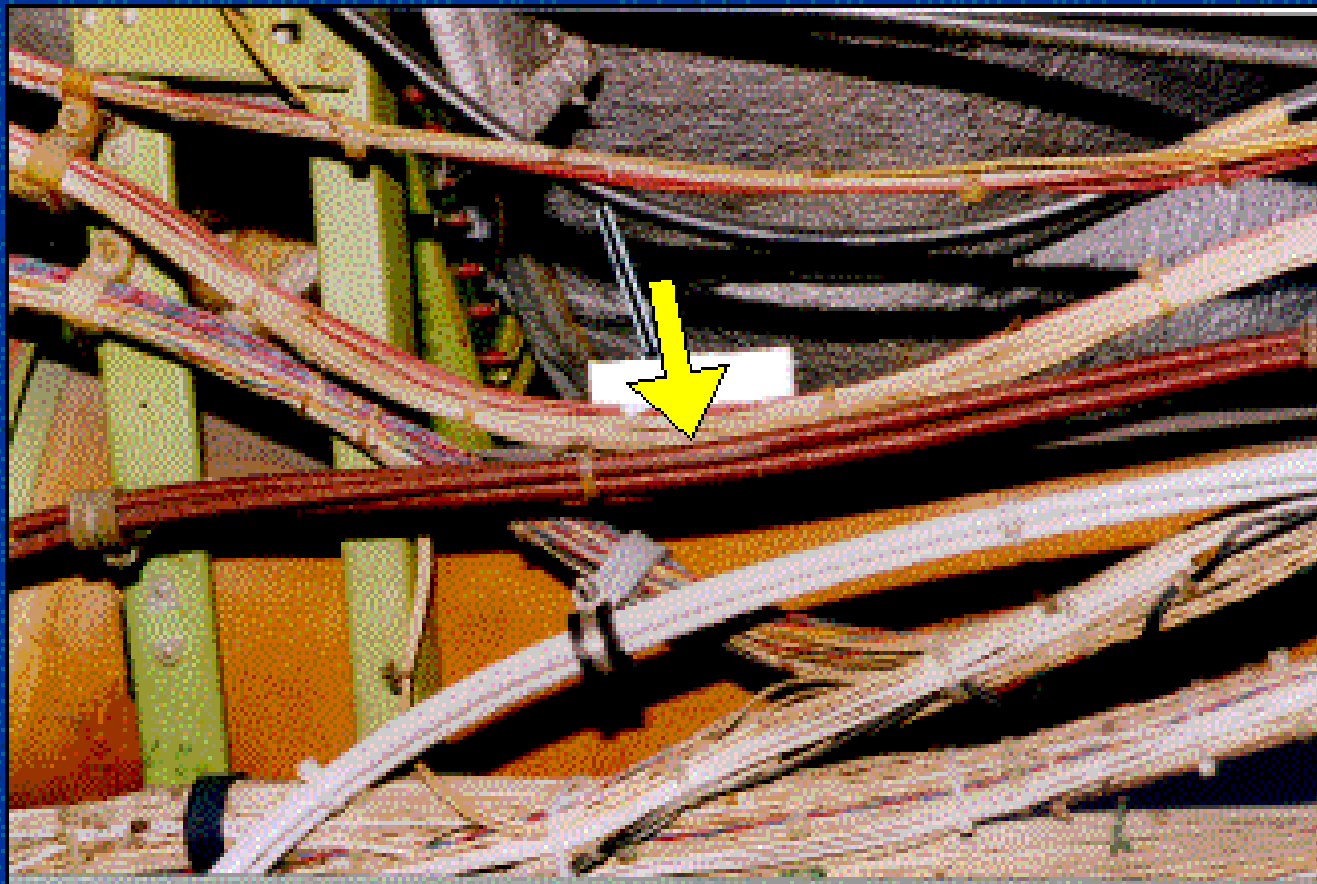
- Other Transport Category Airplanes Inspected
  - Various operators,
  - countries,
  - and ages



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## Chafe of Fuel Gauge and Galley Power Wires (747)





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# Short Circuit Hazards

- System Interruption
- Misleading Display
- In-Flight Fire



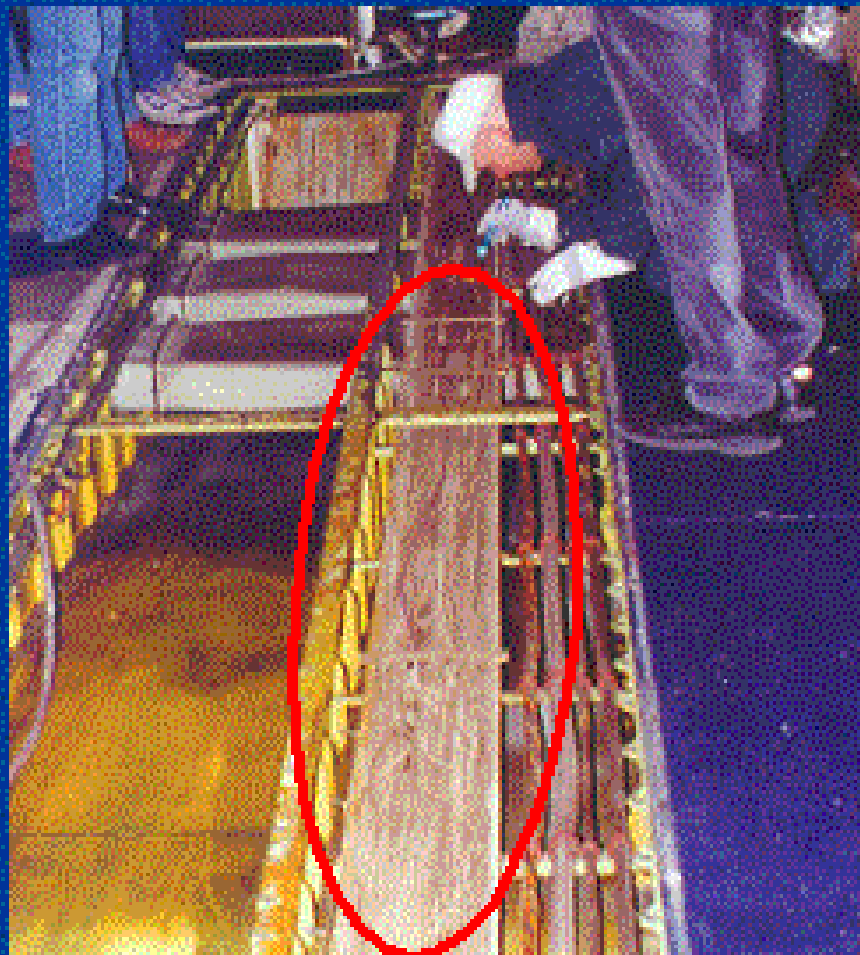
767 Wire Damage at London  
January 9, 1998



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## Wires Loose in Tray (747)







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### Lint in Circuit Breaker Panel (A300)

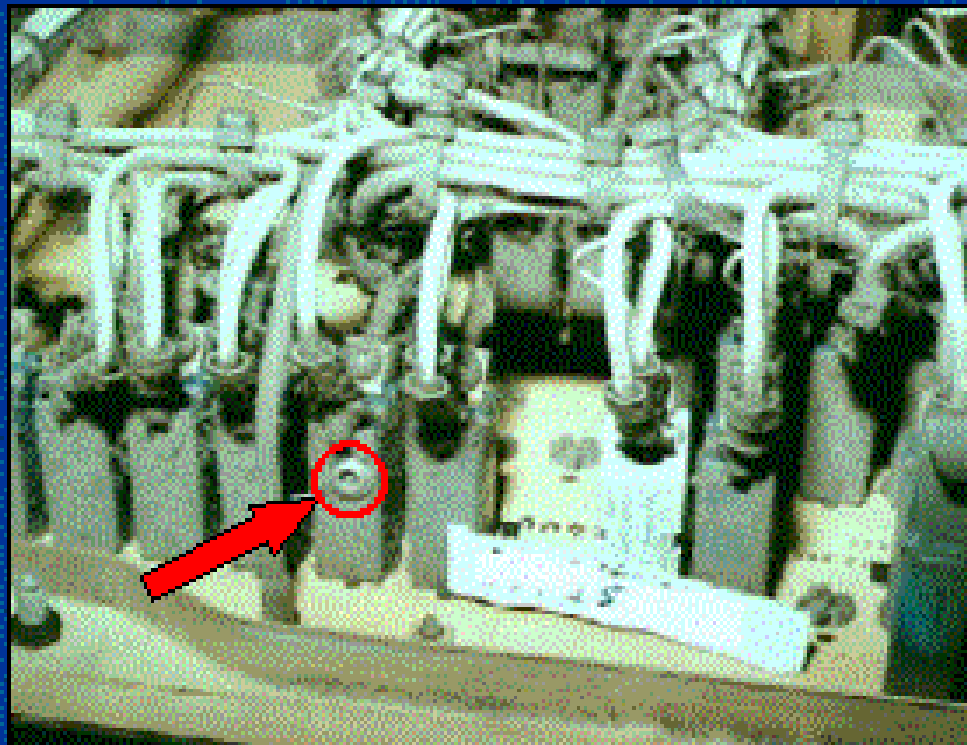




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## Steel Washer On Circuit Breakers (A300)



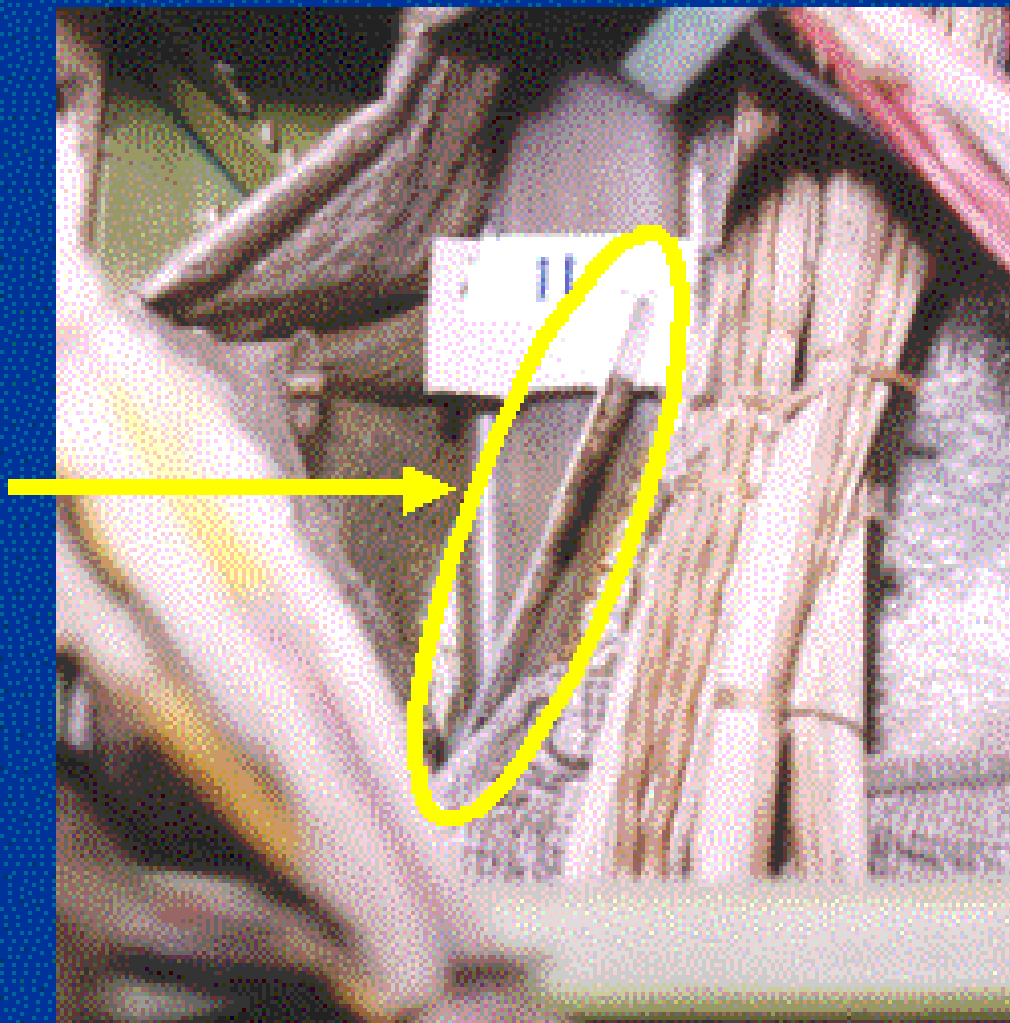


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## Non-Aircraft Hardware Near Wiring (747)

Dinner  
Knife

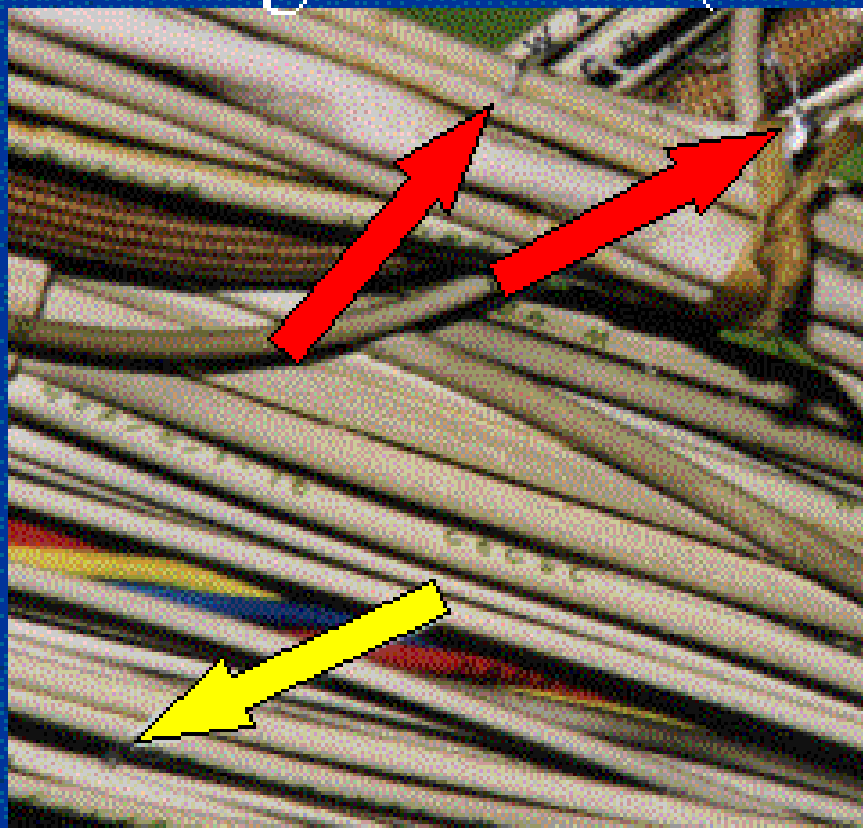




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# Shavings On Top Of Wires And Coming Through Bundle (747)

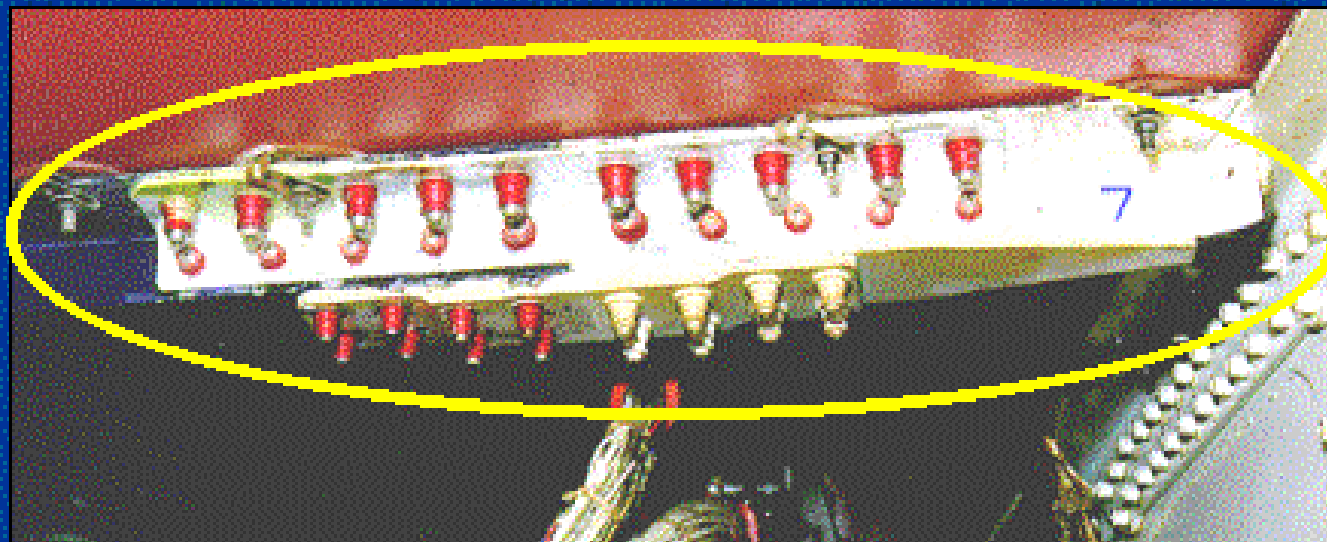




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## Structural Repair Above Metal Shavings On Wires (747)

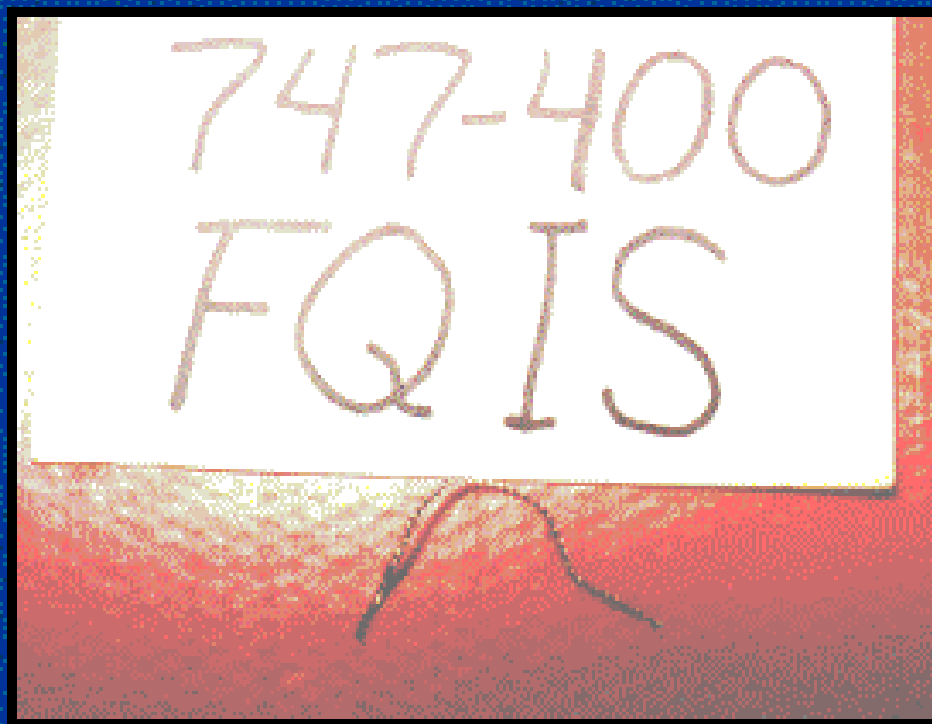




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## Drill Shaving In New Airplane (747-400)

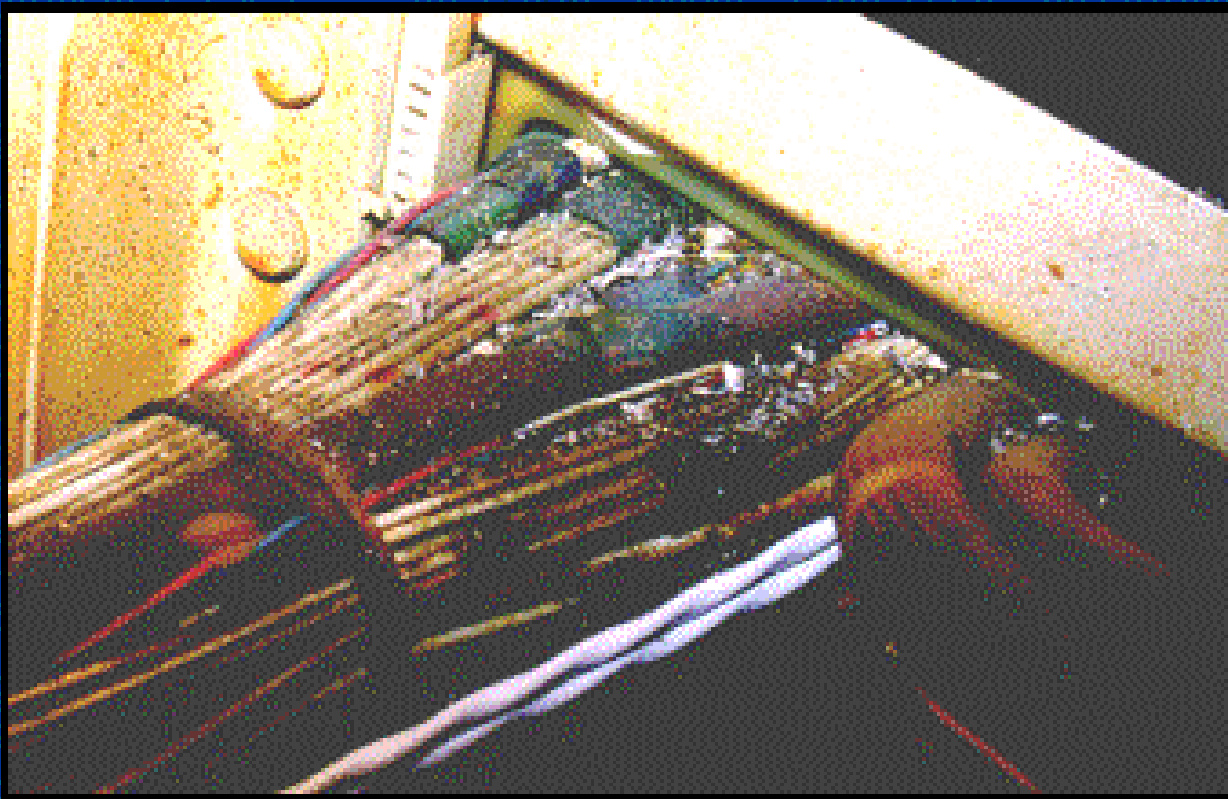




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## **Drill Shaving And Fluid Contamination (747)**

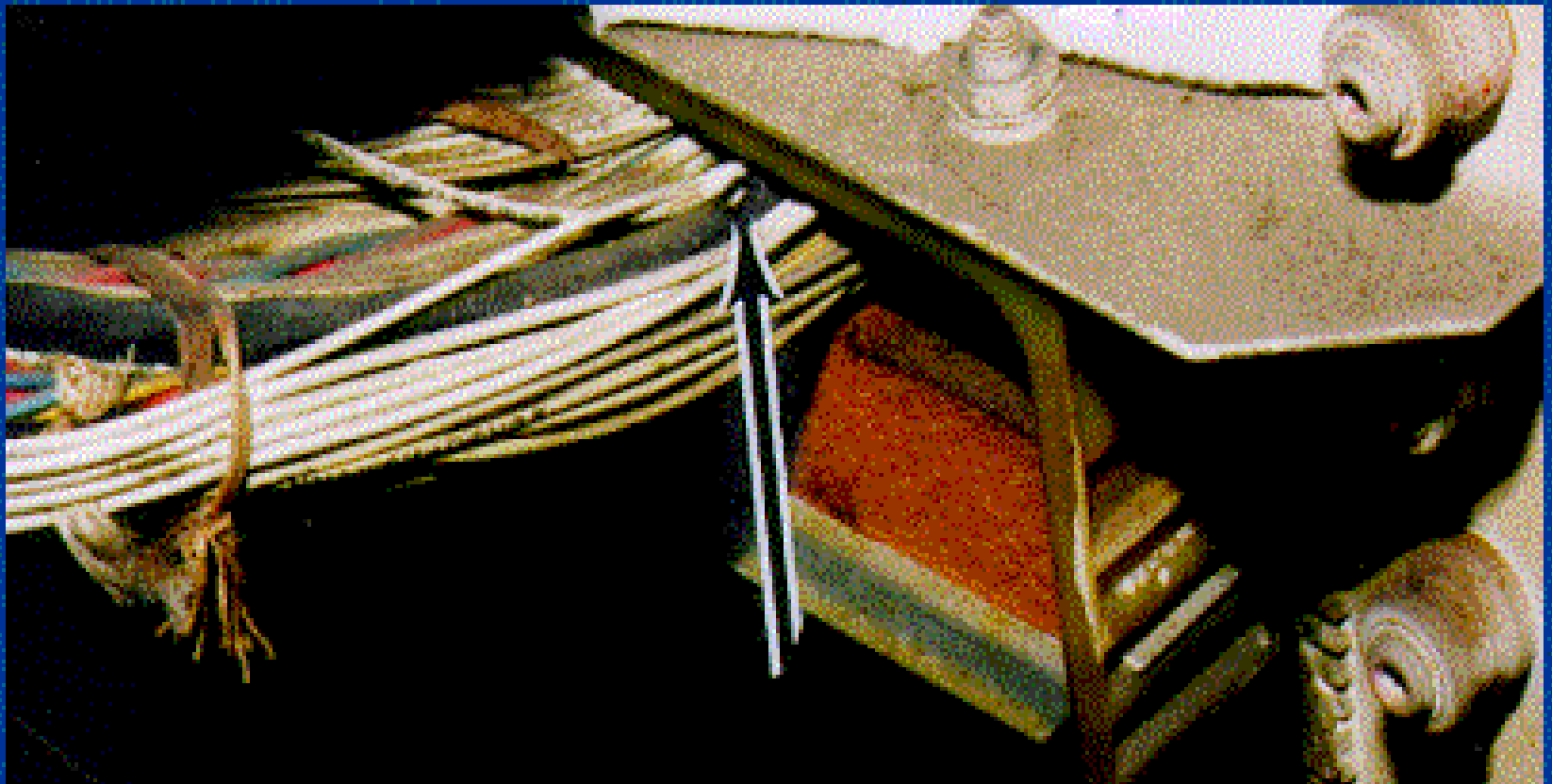




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## **WIRES CAN NOT BE VISIBLY INSPECTED**



**HOLE WORN THROUGH PROTECTION (747)**



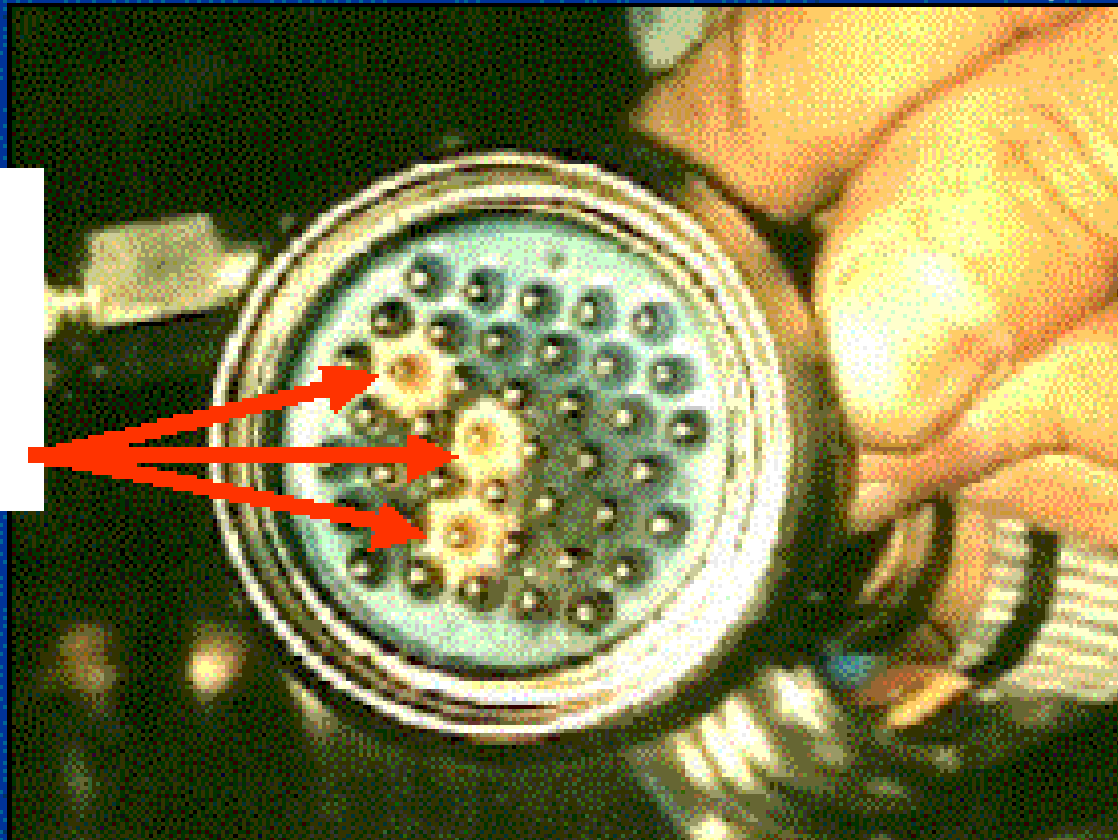


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## Hydraulic Fluid In Connector (747)

Damage  
To Rubber  
Grommet



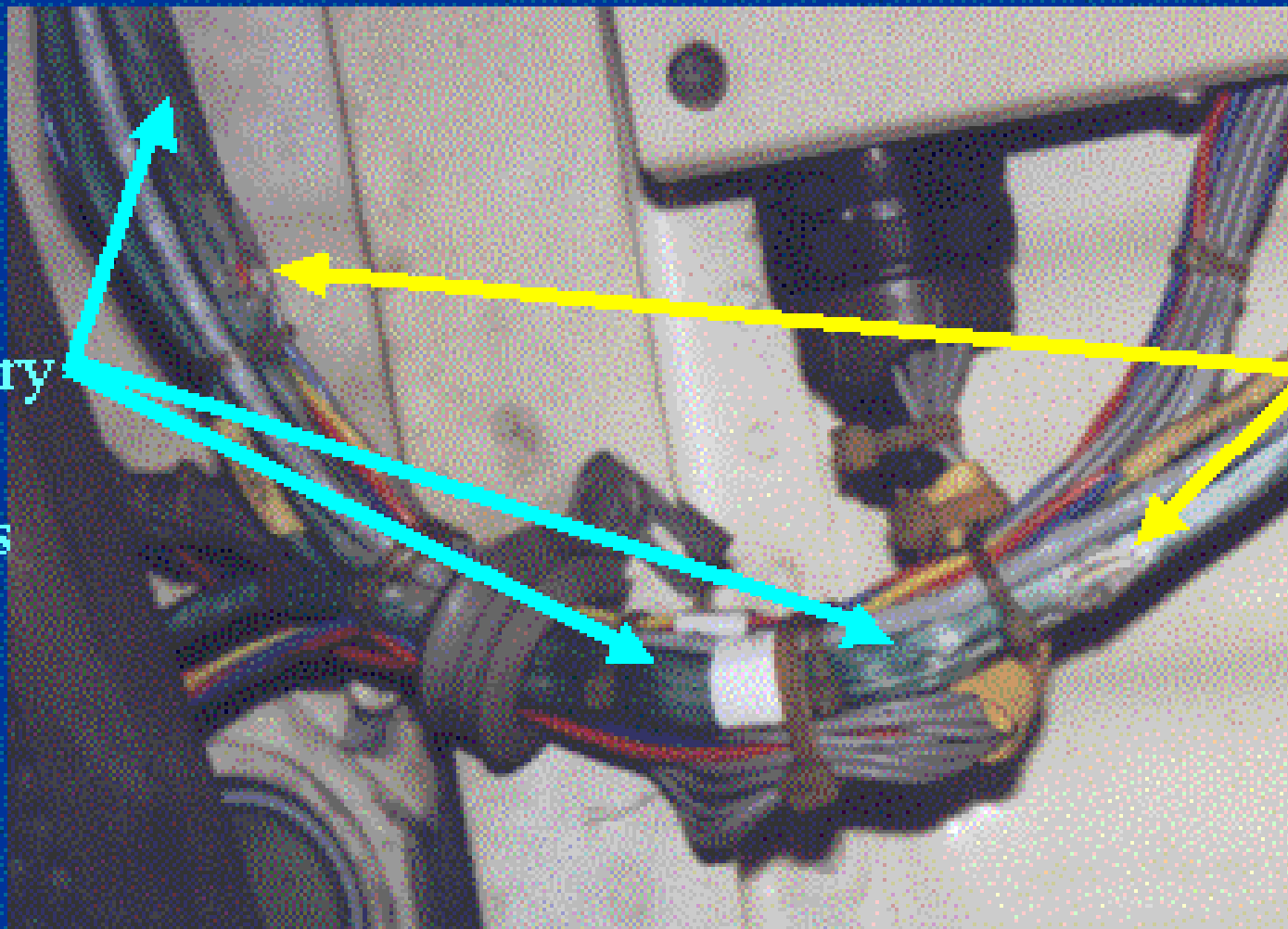
BOEING SERVICE LETTER 747-SL-20-048,  
DATED JANUARY 25, 1995



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## Lavatory Fluid Stains (737)



Blue  
Lavatory  
Fluid  
Stains

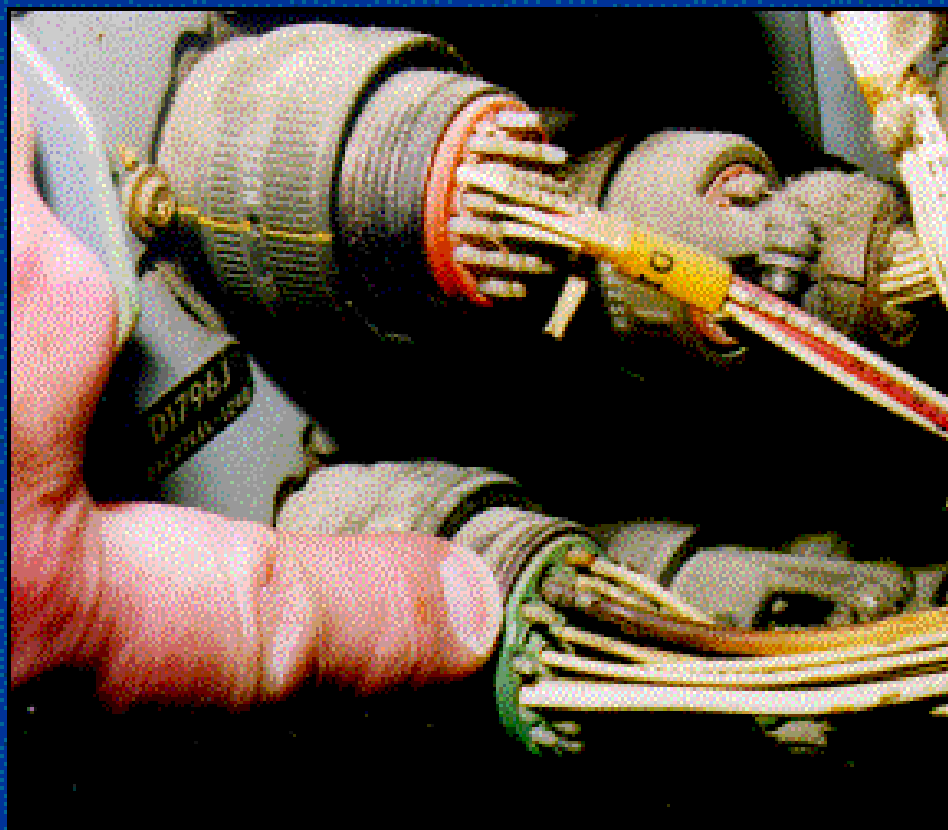
Damaged  
Wire  
Sleeves



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## Overheated Connector Pins (747)

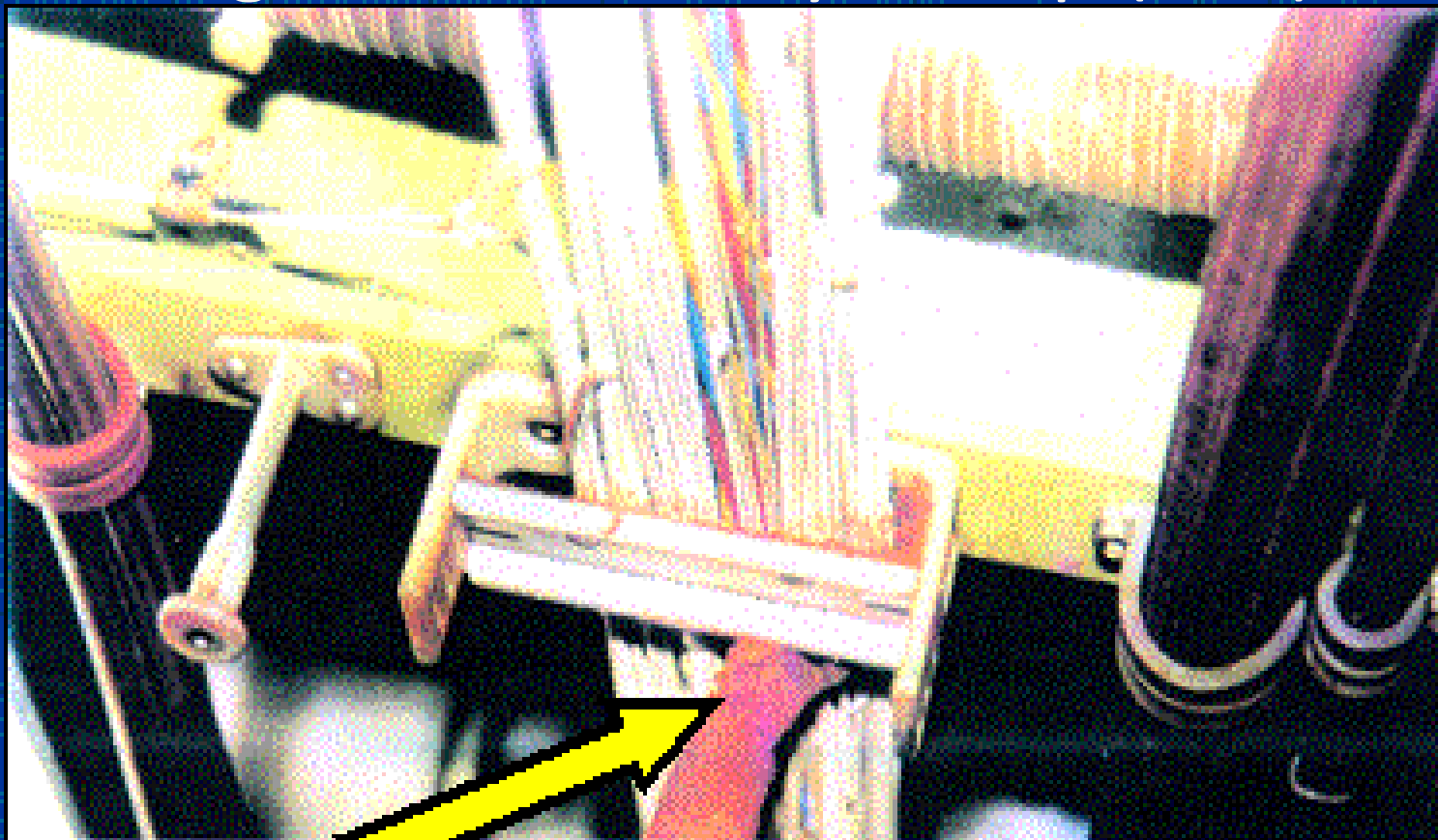




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## Degraded Raceway Clamp (747)



Degraded foam hanging from clamp



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### Principal Causes of Wire Degradation, per Boeing Service Letter 747-SL-20-048, January 25, 1995

- Vibration
- Maintenance (proper and improper)
- Indirect damage (damage resulting from events not directly related to wiring, such as pneumatic duct ruptures)
- Chemical contamination
- Heat

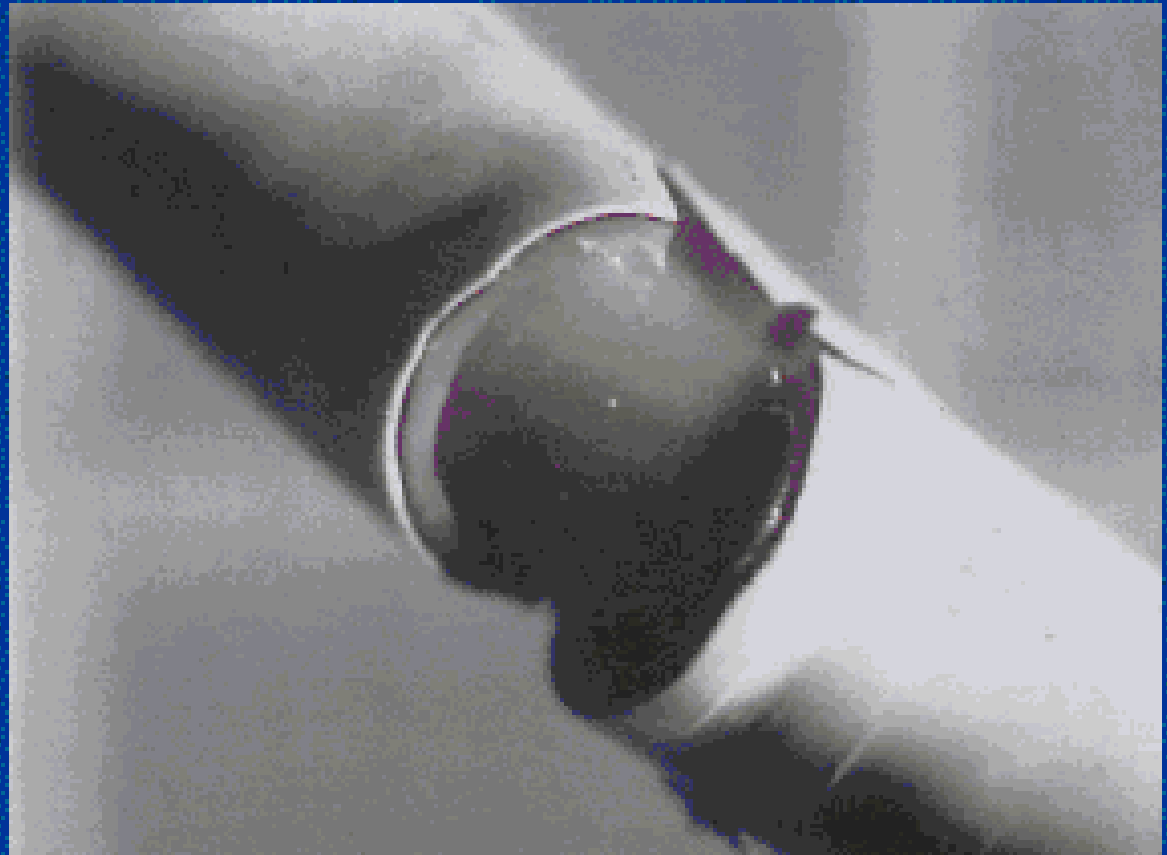


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## Raytheon Material Property Tests

Photo shows inner  
insulation layer is intact  
and copper is not  
exposed



Raytheon caption: "Wire cracked  
after gentle handling"



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# Raytheon Test Results

- Degradation rate related to the installation environment
- Electrical properties were generally met, where wires were not damaged
- No Poly-X samples passed all acceptance criteria and damage was common
- A portion of the damage penetrated to the core of the wires



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## Test Results, General

- No guidance on degradation beyond physical damage criteria
- No requirements for periodically retesting materials
- Aging problems with Poly-X were documented in 1975





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## Standard Wiring Practices Manual

- Describes acceptable materials and practices
- Bulky and difficult to extract data



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## FAA Aging Systems Plan

1. Establish an Aging Transport Systems Oversight Committee
2. Review Aging Transport Fleet
3. Enhance Airplane Maintenance to Better address Aging Airplanes
4. Add Aging Systems Tasks to Research Program



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# FAA Aging Systems Plan, cont.

- Improve Accident/Incident Reporting and Maintenance Actions
- Evaluate Maintenance Needs of Transport Airplane Fuel System Wiring
- Improve Wiring Installation Drawings and Instructions



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## FAA ATSRAC Members

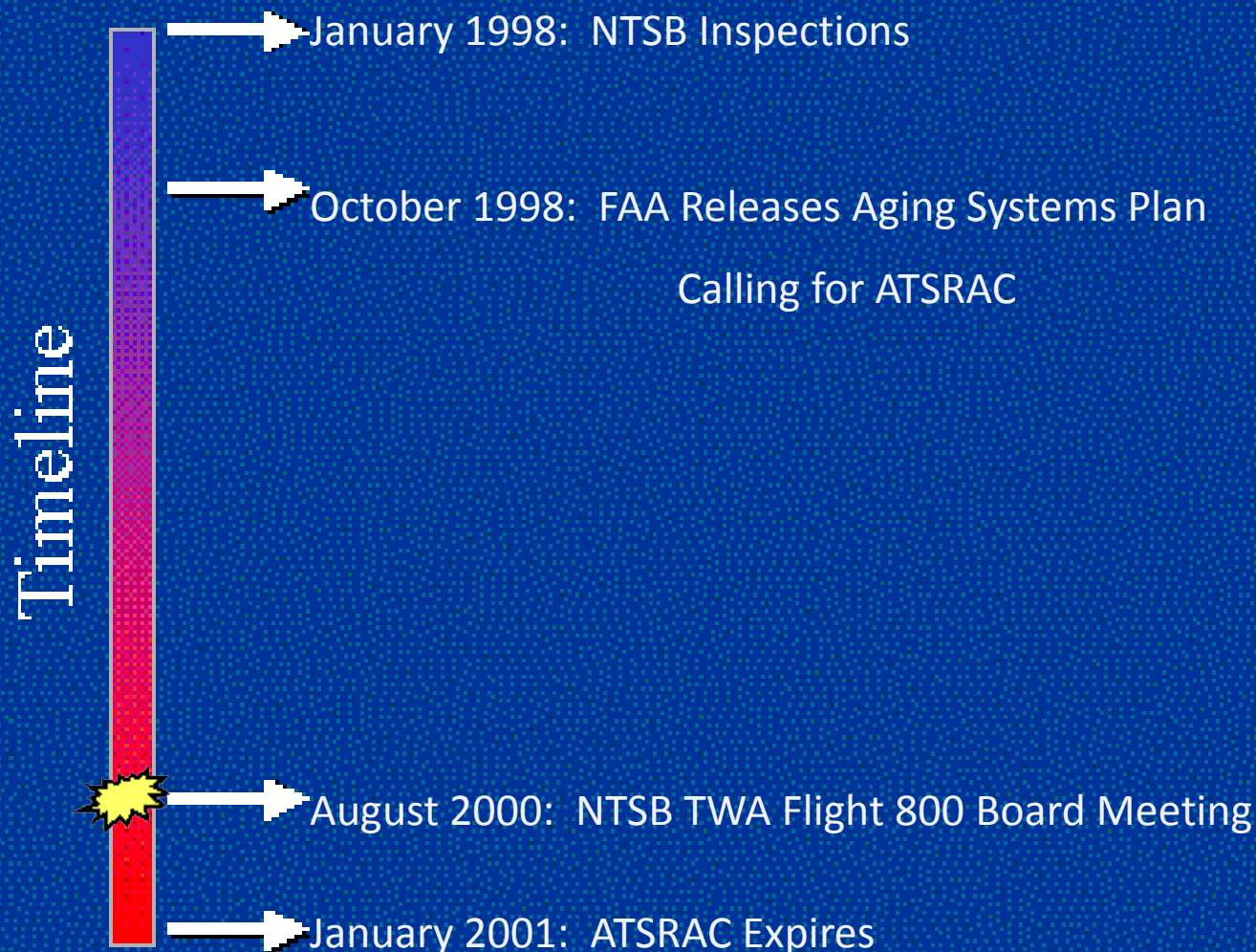
- Government (US & Foreign)
- Wire Manufacturers
- Test Equipment Providers
- Industry Groups
- Aircraft Manufacturers
- Airlines



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## **ATSRAC Charter Expiration**





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# **Recommendations**

- FAA implementation of an earlier safety recommendation (A-91-70) ineffective
- Regardless of the scope of the ATSRAC's eventual recommendations, address all of the issues identified in the Aging Transport Non-Structural Systems Plan and provide the Safety Board with a progress report.



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## **Summary**

- Wiring in the accident airplane was typical for an airplane of its age
- Until TWA 800, insufficient attention had been paid to the condition of wiring